

Appl. No. 10/827,097

Reply to Office action of May 18, 2005/Submission

AMENDMENTS TO THE CLAIMS

1. (previously presented) A method of ink jet printing UV curable ink on a substrate that may be formed of a heat sensitive rigid or other material, the method comprising:

moving a printhead carriage having an ink jet printhead thereon approximately parallel to a substrate;

jetting ink from the printhead across a predetermined distance onto the surface of a substrate;

providing at least one cold UV curing assembly on the carriage oriented to direct UV energy onto the surface of the substrate sufficiently close to where ink is being jetted onto the surface so as to substantially cure dots of the jetted ink on the surface; and

the cold UV assembly being effective to impinge sufficient UV energy on the jetted ink to substantially cure the jetted ink without impinging sufficient radiation of other wavelengths that would heat the substrate so as to deform it to materially alter the predetermined distance between the substrate and the printhead while the substrate is under the printhead; and

applying a vacuum to the substrate to help maintain the predetermined distance between the substrate and the printhead.

Claims 2-8 (canceled)

9. (currently amended) An ink jet printing apparatus for printing with UV curable ink on a substantially rigid substrate having a tendency to deform toward the printhead when heated, the apparatus comprising:

a substrate support defining a substrate supporting plane;

a vacuum source to apply a vacuum to the substrate to help maintain a distance between the substrate and a printhead;

a printhead track extending parallel to the plane having a printhead carriage moveable thereon;

at least one ink jet printhead on the carriage; and

at least one cold UV curing head on the carriage sufficiently close to the ink jet printhead to substantially cure ink in position on the substrate when jetted thereon from the printhead;

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the UV curing head being configured to emit sufficient UV energy to substantially cure the ink jetted onto the substrate without heating and thermally deforming the substrate under the printhead.

Claims 10-11 (canceled)

12. (currently amended) The apparatus of claim 9 wherein:

the at least one UV curing head includes at least two cold UV curing heads lamps, one positioned on the carriage at each side of the printheads so that one leads the printheads and one trails the printheads as the carriage moves on in either of two opposite directions on the track; and

the controller is operable to activate at least one of the UV curing head's lamps to expose the ink jetted by the printheads on the surface of the substrate.

Claim 13 (canceled)

Claims 14 and 15 (canceled)

Claims 16-18 (canceled)

Claims 19-26 (canceled)

27. (previously presented) A method of dispensing UV curable ink from a printhead onto a substantially rigid substrate formed of a material that has a tendency to deform at least temporarily if exposed to radiant energy, the method comprising:

moving a printhead with a cold UV assembly approximately parallel to a substrate at a printing station;

dispensing ink from the printhead onto a surface of the substrate;

applying a vacuum to the substrate to help hold the substrate in place; and

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directing UV radiation from the cold UV assembly onto the surface of the substrate to substantially cure the ink without impinging radiation that would materially deform the substrate while the substrate is at the printing station so as to materially alter the distance between the substrate and the printhead.

Claims 28, 29, and 30 (canceled)

31. (previously presented) An ink jet printing apparatus for printing upon a substrate, the ink jet printing apparatus comprising:

- a vacuum table configured to hold a substrate via a vacuum;
- a printhead carriage;
- a printhead coupled to and movable with the printhead carriage to different positions with respect to the substrate; and
- a cold UV curing head coupled to and movable with the printhead carriage and configured to direct an amount of UV energy toward the substrate, the amount of UV energy sufficient to substantially cure ink dispensed from the printhead upon the substrate, but insufficient to substantially thermally deform the substrate.

32. (previously presented) The apparatus of claim 31 wherein:
the substrate is foamboard.

33. (canceled)

34. (previously presented) The apparatus of claim 31 wherein the cold UV curing head includes a limited bandwidth UV source.

35. (previously presented) The apparatus of claim 31 wherein the cold UV curing head comprises:

- at least one UV lamp;

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a reflector having a surface configured to direct UV light onto the substrate from behind the at least one UV lamp; and
a fluid cooling system coupled to the reflector.

36. (previously presented) An ink jet printing apparatus for printing upon a substrate, the ink jet printing apparatus comprising:

a printhead carriage;
a printhead coupled to and movable with the printhead carriage to different positions with respect to the substrate; and

a cold UV curing head configured to direct an amount of UV energy toward the substrate, the amount of UV energy sufficient to at least substantially cure ink dispensed from the printhead upon the substrate, but insufficient to substantially thermally deform the substrate, the cold UV curing head including

at least one lamp fixed relative to the printhead that emits UV light;
a reflector having a surface configured to direct UV light onto the substrate from behind the at least one lamp;

a fluid cooling system coupled to the reflector; and

a hollow tube, substantially transparent to UV radiation, substantially absorbent of infrared radiation, and formed of a temperature and radiation tolerant material, the tube extending the length of the head and being positioned between the at least one lamp and the substrate.

37. (previously presented) The apparatus of claim 36 wherein the cold UV curing head further comprises:

a second fluid cooling system coupled to the tube to remove heat energy from infrared radiation by the tube.

38. (previously presented) The apparatus of claim 31 wherein the cold UV curing head comprises:

at least one lamp fixed relative to the printhead that emits UV light;

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the at least one lamp consuming power of at least approximately 125 watts per linear inch.

39. (previously presented) The apparatus of claim 31 wherein the cold UV curing head comprises:

at least one lamp fixed relative to the printhead that emits UV light;
the at least one lamp being capable of being operated at a power consumption of at least 200 watts per linear inch.

40. (previously presented) The apparatus of claim 31 wherein the cold UV curing head comprises:

at least one lamp fixed relative to the printhead that emits UV light;
a reflector having a surface configured to direct UV light onto the substrate from behind the at least one lamp; and
a fluid cooling system coupled to the reflector.

Claims 41-44 (canceled)

45. (previously presented) An ink jet printing apparatus for printing upon a deformable substrate, the apparatus comprising:

a printhead carriage;
a printhead coupled to and movable with the printhead carriage to different positions with respect to the deformable substrate and configured to jet ink onto the deformable substrate;
a vacuum table configured to hold the substrate via a vacuum; and
a cold UV curing head on the printhead carriage configured to direct UV energy onto the deformable substrate so as to substantially cure the jetted ink without directing energy that would substantially deform the substrate;
the cold UV curing head including at least one lamp,
a reflector with a surface configured to direct UV light from the at least one lamp onto the deformable substrate, and

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a cooling system configured to take heat away from the curing head.

46. (previously presented) An ink jet printing apparatus for printing upon a deformable substrate, the apparatus comprising:

a printhead carriage;

a printhead coupled to and movable with the printhead carriage to different positions with respect to the deformable substrate;

a substrate support table configured to support the deformable substrate for printing thereon by the printhead; and

a cold UV curing head on the carriage configured to direct UV energy toward the substrate;

the cold UV curing head including at least one lamp having a power consumption of at least approximately 125 watts per linear inch;

a hollow tube, substantially transparent to UV radiation, substantially absorbent of infrared radiation, and formed of a temperature and radiation tolerant material, the tube extending the length of the head and being positioned between the at least one lamp and the substrate; and

a second fluid cooling system coupled to the tube to remove heat energy from infrared radiation by the tube.

47. (previously presented) The apparatus of claim 45 wherein the cold UV curing head comprises:

at least two lamps, one on each side of the printhead, each having a reflector with a surface configured to direct UV light onto the deformable substrate from behind each lamp; and the apparatus further comprising a cooling system configured to take heat away from each reflector.

48. (previously presented) The apparatus of claim 45 wherein the vacuum table has vacuum ports therein and a vacuum system coupled to the ports.

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49. (previously presented) The apparatus of claim 45 wherein the substrate is foamboard.
50. (previously presented) A method of ink jet printing with UV curable ink onto a rigid substrate held by a vacuum to a support surface, the method comprising:
- moving a printhead carriage having an inkjet printhead and cold UV assembly thereon substantially parallel to the substrate;
 - applying a vacuum to the substrate;
 - jetting ink from the printhead onto the substrate while the substrate is held by the vacuum; and
 - directing UV energy from the cold UV assembly onto the substrate while the substrate is held by the vacuum to substantially cure the ink without impinging sufficient energy that would deform the substrate under the printhead so as to substantially change the distance between the printhead and the substrate.
51. (previously presented) An ink jet printing apparatus for printing upon a rigid substrate, the ink jet printing apparatus comprising:
- a printhead carriage;
 - a printhead coupled to and movable with the printhead carriage to different positions with respect to the substrate;
 - a vacuum table configured to hold a substrate in place via a vacuum and help maintain a distance between the substrate and the printhead; and
 - a cold UV curing head coupled to and movable with the printhead carriage and configured to direct energy onto the surface of the substrate so as to substantially cure the jetted ink without impinging sufficient energy that would deform the substrate under the printhead so as to substantially alter the distance between the substrate and the printhead.
52. (previously presented) A method of printing UV curable ink on a heat-sensitive substrate, the method comprising:
- moving a printhead carriage having a printhead and cold UV source thereon approximately parallel to a substrate;

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dispersing UV curable ink from the printhead onto the substrate;
emitting sufficient UV energy from the UV source onto the substrate to substantially cure the ink, while simultaneously a) filtering undesired energy emitted by the UV source so as to prevent the substrate from deforming to a level that would materially diminish print quality, and b) holding the substrate in place; and
removing heat generated by the UV source with a cooling system.

53. (previously presented) An ink jet printer for printing UV curable ink on a heat-sensitive substrate, the apparatus comprising:
a printhead carriage;
a printhead coupled to and moveable with the printhead carriage;
at least one UV curing assembly coupled to and moveable with the printhead carriage, the UV curing assembly having one or more filters configured to prevent at least a portion of undesired energy emitted from the UV curing assembly from contacting the substrate;
a vacuum table for assisting in holding the substrate down and in place; and
a cooling system to remove heat generated by the UV source,
wherein the printer is configured to substantially cure ink while maintaining a distance between the substrate and the printhead by emitting sufficient UV energy to substantially cure the ink dispersed onto the substrate, and filtering undesired energy emitted by the UV curing assembly.